Geostationary Operational Environmental Satellite (GOES)

R Series

Flight Project

Spacecraft

Work Breakdown Structure (WBS) Dictionary

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GOES-R Spacecraft

Work Breakdown Structure (WBS)

Dictionary

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1.0 Spacecraft #1

The Contractor **shall** include within this WBS element at a minimum, all sub-elements to the level described in this document. This will assist the government in organizing, describing, and reporting the design, analysis, fabrication, assembly, integration, testing, and operation of the GOES-R satellite.

The Contractor **shall** organize and report design and analysis separately from fabrication, assembly and test in separate WBS sub-elements.

The Contractor **shall** organize and report non-recurring and recurring cost in separate WBS sub-elements.

1.1 Program Management

1.1.1 Program Management Office

Program management is the business and administrative planning, organizing, directing, coordinating, controlling, and approval processes used to accomplish overall program objectives, which are not associated with specific hardware or software elements. This element includes project reviews and documentation, non-project owned facilities, and project reserves. It excludes costs associated with technical planning and management, and costs associated with delivering specific engineering, hardware and software products.

1.1.2 Resource Management

Resource Management is the program control and management systems that provide for Work-Breakdown Structure (WBS) development, acquisition management, information technology management, resource management, Earned-Value Management (EVM), facilities, environmental, logistics and schedule management.

1.1.2.1 Configuration and Information Management

Configuration management (CM) is the control of performance, functional and physical characteristics over the program and product life cycle. Configuration management is applied to requirements, documentation, software and hardware. Hardware includes qualification hardware; engineering, proto-flight, flight hardware; and ground support equipment.

1.1.2.2 Information Technology Management

Information technology (IT) management is technical and management efforts to provided software and hardware infrastructure support.

1.1.3 Risk Management

Risk Management (RM) is the continuous, iterative, and proactive process to manage risk and achieve mission success. The process involves identifying, analyzing, planning, tracking, controlling, documenting, and communicating risks effectively. Risk is characterized by the combination of the probability or likelihood that the program will experience an event and the consequences, impact, or severity of the event, were it to occur.

1.2 Systems Engineering (SE)

Systems engineering is the technical and management efforts of directing and controlling an integrated engineering effort for the project. This element includes the efforts to define the spacecraft, conducting trade studies; the integrated planning and control of the technical program efforts of design engineering, software engineering, system architecture development, and integrated test planning, system requirements writing, configuration control, technical oversight, control and monitoring of the technical program. Documentation Products include mission/system requirements document (MSRD); interface control documents (ICDs); and verification and validation (V&V) plan. Excludes any design engineering costs.

1.2.1 Instrument Interfaces

This sub-element describes and organizes SE resources specific to the accommodation of instruments.

1.2.2 Ground Interfaces

This sub-element describes and organizes SE resources specific to ground interfaces.

1.2.3 Launch Interfaces

This sub-element describes and organizes SE resources specific to launch interfaces.

1.2.4 Image Navigation and Registration (INR)

This sub-element describes and organizes SE resources specific to INR.

1.2.5 Contamination

This sub-element describes and organizes SE resources specific to contamination.

1.3 Safety & Mission Assurance (S&MA)

Safety and Mission Assurance is the technical and management efforts of directing and controlling the safety and mission assurance elements of the project. The mission success criteria intended to assure that the delivered spacecraft, ground systems, mission operations, and payload(s) meet performance requirements and function for their intended lifetimes include the following elements; design, development, systems safety, industrial safety, quality assurance, reliability, parts control, materials and process control, environmental verification, contamination control, workmanship standards and processes, software assurance, and design/technical reviews of all systems and instruments. At the subcontractors level an oversight level exist with a direct relation between NASA and the prime S/C and Instrument Developer’s.

1.4 Spacecraft

The spacecraft bus is the platform for carrying payloads, instruments, and other mission-oriented equipment in space to achieve the mission objectives. This element includes all design, analysis, fabrication, assembly, test efforts to deliver the spacecraft bus for integration with the instruments. This element does not include integration and test with instruments, ground system, or launch vehicle.

1.4.1 Spacecraft Management

The Spacecraft Management element includes all resources related to systems engineering, project management, and integration and test of the bus hardware and software. As stated above, this element does not include integration and test with instruments, ground system, or launch vehicle.

1.4.2 Mechanical

The Mechanical element is defined as the bus structure and mechanisms. It includes all resources related to the design, development, production, positioning, integration and test of the bus structure and mechanical parts. Any structure and mechanism support equipment is also included.

1.4.3 Thermal

The Thermal element is defined as the active and passive devices, and thermal support equipment. It includes all resources related to the design, analysis, fabrication, assembly, and test of the active and passive thermal components.

1.4.4 Guidance, Navigation and Control (GN&C)

The GN&C element includes all orbit determination, orbit control, attitude determination and attitude control functions. It includes all related GN&C flight hardware components, flight software and propulsion interfaces; as well any necessary GN&C support equipment. It includes all activities related to the design, development, production, integration, test, launch and on-orbit checkout of the above components.

1.4.5 Command and Data Handling (C&DH)

The C&DH element is defined as command and telemetry electronics, Spacewire and GN&C support equipment. It includes all resources related to the design, analysis, fabrication, assembly, and test of the above components.

1.4.6 Communications (COMM)

1.4.6.1 Space/Ground Communication

The Communications element is defined as the, antennas, all active and passive Radio Frequency (RF) components including but not limited to MMICs, filters, hybrids, attenuators and communications support equipment. This includes the RF sections of the Telemetry, Tracking, and Command (TT&C) subsystem. It includes all resources related to the design, analysis, fabrication, assembly, and test of the above components.

1.4.6.2 Auxiliary Communication Services

The Unique Payload Services element encompasses the structure, software, and support equipment of the GOES Rebroadcast service (GRB), Data Collection System (DCS), Low-Rate Information Transfer (LRIT), Search-and-Rescue Satellite (SARSAT), and Emergency Managers Weather Information Network (EMWIN). It includes all resources related to the design, analysis, fabrication, assembly, and test of the above components.

1.4.7 Electrical

The Electrical element is defined as the electrical power generation, power conditioning, power storage, harnesses, cables, and electrical support equipment. It includes all resources related to the design, analysis, fabrication, assembly, and test of the above components.

1.4.7.1 Electrical Distribution

The Electrical Distribution element is defined as the harnesses, cables, and support equipment. It includes all resources related to the design, analysis, fabrication, assembly, and test of the above components.

1.4.7.2 Power

The Power element is defined as the electrical power generation, power conditioning, and power storage. It includes all resources related to the design, analysis, fabrication, assembly, and test of the above components.

1.4.8 Propulsion

The Propulsion element is defined as the tanks, plumbing, thrusters, propellants, and propulsion support equipment. It includes all activities related to the design, development, production, integration, test, launch and on-orbit checkout of the above components.

1.4.9 Flight Software

The Flight Software element for the Bus subsystem encompasses the flight software for components of the bus, to include the Thermal, GN&C, C&DH, Communications, Electrical, Magnetometer, and Propulsion elements. The primary activities for the Flight Software element are systems engineering, software project management, algorithm development, and subsystem integration and test. The activities of requirements analysis, design, coding and unit testing, and unit integration and testing are also included.

1.4.10 Magnetometer

The Magnetometer element encompasses the magnetometer sensor, structure, mechanisms, and magnetometer support equipment. It includes all resources related to the design, analysis, fabrication, assembly, and test of the above components.

1.5 Ground Support Equipment (GSE)

This element includes the resources all GSE required to assemble, integrate, and test the spacecraft.

1.5.1 Mechanical GSE (MGSE)

This element includes the resources required to provide MGSE.

1.5.2 Electrical GSE (EGSE)

This element includes the resources required to provide EGSE.

1.5.3 GSE Software

This element includes the resources required to provide non-flight software.

1.5.4 Simulators

This element includes the resources required to provide spacecraft simulators.

1.6 Integration and Test (I&T)

This element includes the resources required to perform the integration and test of the spacecraft bus, instruments, payloads, launch vehicle, and ground system.

1.6.1 Spacecraft Bus I&T

This element includes the resources required to perform the integration and test of the spacecraft subsystems including COMM and the magnetometer onto the spacecraft bus.

1.6.2 Satellite I&T

This element includes the resources required to perform the integration and test of the GFP instruments onto the spacecraft.

1.6.3 Functional and Performance Testing

This element includes the resources required to perform functional and performance Testing

1.6.4 Environmental and Verification Testing

This element includes the resources required to perform environmental and verification Testing

1.6.5 Satellite/Launch Vehicle I&T

This element includes the resources required to perform integration of the satellite onto the launch vehicle

1.6.6 End-to-End (ETE) Testing

This element includes the resources required to perform ETE Testing.

1.6.7 Transportation and Handling

This element includes the resources required to perform transportation and handling

1.6.8 Storage

This element includes the resources required to provide storage of the spacecraft bus, spacecraft, GFP instruments, and satellite.

1.7 Launch and Operations

This element includes the resources required to perform launch operations of the satellite.

1.8 Post Delivery Support

This element includes the resources required to perform sustaining engineering support of the satellite.

1.9 Special Studies & Tasks

This element includes the resources required to perform special studies and tasks as directed by the government.

1.10 Education & Public Outreach

This element includes the resources required to perform education and public outreach.

2.0 Spacecraft #2

The Contractor **shall** include within this WBS element at a minimum, all sub-elements to the level described in this document. This will assist the government in organizing, describing, and reporting the design, analysis, fabrication, assembly, integration, testing, and operation of the GOES-S satellite.

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The Contractor **shall** organize and report non-recurring and recurring cost in separate WBS sub-elements.

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